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PEST ALERT

Florida Department of Agriculture and Consumer Services, Division of Plant Industry
Charles H. Bronson, Commissioner of Agriculture

The Red Ring Nematode, Bursaphelenchus cocophilus (Cobb, 1919) Baujard, 1989 (Nematoda: Tylenchida)

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INTRODUCTION: The red ring nematode, *Bursaphelenchus cocophilus*, causes lethal red ring disease of palms. Hosts of this nematode are confined to the family Palmae, in which the nematode is known to infect over 17 species. *Bursaphelenchus cocophilus* has not been reported in the continental United States, Virgin Islands or Hawaii. This nematode causes severe damage to coconut (*Cocos nucifera*) and African oil (*Elaeis guineensis*) palms, including stunted and eventual death from nematode infection. Red ring disease of palm is one of the most important wilt diseases of these two palms in the Neotropics where it causes 10-15% loss annually. The world distribution of *B. cocophilus* includes: Belize, Brazil, Colombia, Costa Rica, Ecuador, El Salvador, French Guiana, Grenada, Guatemala, Guyana, Honduras, Mexico, Nicaragua, Panama, Peru, Saint Vincent and the Grenadines, Suriname, Trinidad and Tobago, and Venezuela. Although the nematode has been reported to be present in Barbados, Dominica and Jamaica, these reports have not been confirmed.

DESCRIPTION: Females and males of *B. cocophilus* are 60-139 and 65-179 times longer than wide, respectively, with the greatest body width being less than 15.5 µm and total length ranging from 775-965 µm from little leaf symptomatic African oil palm and 812-1369 µm from coconut or African oil palms with typical red ring symptoms (Fig. 1). The metacorpus and stylet in the second-stage juveniles and adults are well developed. Stylet length is between 11-15 µm in adults. Females have a vulval flap which appears bowed posteriorly when viewed ventrally, a long post-uterine sac (extending about 75% of the vulva-anal distance) and an elongate tail (62-117 µm) with a rounded terminus. Males have seven caudal papillae; one ventral preanal papilla, one pair of subventral preanal or adanal papillae and two pairs of subventral postanal papillae. The distal ends of the spicules in the males are heavily sclerotized, and the caudal alae form a spade-shaped flap (= bursal flap). Third-stage dauer juveniles from coconut palm usually range from 700-920 µm and have a pointed tail with or without a mucron. The metacorpus is usually not well developed in dauer juveniles from the palm or the weevil vector and the stylet is not visible.

BIOLOGY AND LIFE CYCLE: *Bursaphelenchus cocophilus* is vectored by the red palm weevil, *Rhynchophorus palmarum* which transmits it to the coconut palm, *Cocos nucifera*, and the African oil palm, *Elaeis guineensis* (Fig. 2). The red ring nematode is co-distributed with the palm weevil in the lower Antilles and Mexico southward into South America. Adult females, which are internally infested by *B. cocophilus*, disperse the dauer juvenile nematodes to healthy coconut palms and deposit the juvenile stage of the nematode during oviposition, usually at the leaf axils or internodes. Nematodes enter oviposition wounds, feed and reproduce in the palm tissues, causing the death of the infected trees. The weevil larvae are infested with as many as 10,000 juveniles of *B. cocophilus* (Fig. 3). The nematode juveniles persist in the insect through metamorphosis, apparently without molting, and appear to aggregate around the genital capsule of the adult weevil. The adult weevils emerge from their cocoons in the rotted palm and disperse to apparently healthy, stressed

and dying palms, completing the life cycle. Other beetles, *Dynamis borassi* (F.) and *Metamasius hemipterus* (L.), are also reported to vector the red ring nematode.

SYMPTOMS: Symptoms of red ring disease vary widely with palm species and age, cultivar and environmental conditions. Palms younger than 2.5 years old cannot be experimentally infected with *B. cocophilus*, and red ring disease has not been recorded from palms of this age in the field. In *C. nucifera*, classical red ring symptoms include premature nut fall (except for mature nuts), withering of inflorescences, yellowing, bronzing and death of progressively younger leaves. Yellowing of leaves usually starts at the tips of the pinnae and moves inward to the rachis and then to the base of the petiole. Several of the dying or dead leaves often break close to the petiole and remain hanging from the stem (Fig. 4).

A stem transverse section will reveal a discrete brick to brownish-red ring that is 2-6 cm wide and occurs 2-6 cm within the stem periphery (Fig. 5). The leaf petioles and cortex of roots can also be discolored yellow to brownish-red. In longitudinal section, discoloration is usually continuous throughout the length of the stem, appearing as two bands that unite at the base and form discontinuous lesions near the crown. In African oil palm, classical symptoms involve progressive premature yellowing and death of older leaves that break at the petiole and hang from the stem. Stem transverse sections reveal a brown, cream or rose-colored ring that is a few centimeters wide and is concentric to the periphery of the stem. Irregularly-shaped rings and rings that are not continuous through the stem are common. These specific differences in symptoms were consistent in both coconut and African oil palms in cross inoculations, regardless of the inoculum origin.

Coconut palms from 3-10 years-old and African oil palms more than 5 years old usually die within 2-4 months of infection. Severe damage to the crown of red ring-diseased coconut palms is caused by larval feeding of the large weevil vector, *R. palmarum*. Older coconut palms (> 20 years old) with red ring disease have been reported displaying less definitive symptoms with a more prolonged death. Dauer juveniles can be harvested from the discolored tissue of the ring from coconut (up to 11,000 nematodes/g of tissue), from leaf petioles or roots to confirm disease diagnosis from symptoms. Nematode recovery from African oil palms is highly variable. Chronic little leaf symptoms caused by *B. cocophilus* have also been reported for coconut palms, especially in older trees. Coconut palms begin abnormal production of very short leaves which give crowns the unusual appearance of a feather duster. As the disease progresses, there can be a decrease in leaf size and surface until the leaf is reduced to a bare rachis with suberized lesions over most of its surface. New leaves and inflorescences are aborted and fruit production ends.

Red ring nematodes can be recovered from necrotic lesions in the middle and distal parts of unpresented leaves. Little leaf and a combination of red ring and little leaf symptoms can be more common in African oil palms.

REGULATORY CONSIDERATIONS: *Bursaphelenchus cocophilus* and its weevil vector (*R. palmarum*) do not colonize and damage coconut fruit in nature. There is no clear evidence of *B. cocophilus*' detection in coconut seeds. However, the husks surrounding the seeds, if damaged, can attract the weevil. Thus, the removed husks could produce kairomones that are attractive to weevils. The importation of de-husked coconut fruit for consumption into the United States is safe because the coconut seeds do not contain palm weevils and/or nematodes. In Florida and other states with strong agriculture, there is a great demand for organic matter to be used as a soil conditioner or as a component of soil mixes for containerized plant production. More than one million cubic yards of organic matter including compost, coconut fiber, peat, sphagnum and other organic compounds are used annually in Florida by the ornamental plant industry. Peat and peat substitutes are the preferred organic compounds used by the industry. A common peat substitute involves ground coconut husk fibers (coir) originating from tropical countries. The introduction of improperly composted and refined coir from the Neotropics in Latin America poses the dual risk of introducing the weevil vector and the red ring nematode. The Florida Department of Agriculture and Consumer Services discourages soil formulators from using coir from unverified sources in the Far East and Latin America where improper drying, processing or shipping may be an issue.

The introduction of coir from the Far East is relatively safe because the red ring disease of coconut palms does not occur there. However, a quarantine weevil, the red palm weevil, *R. ferrugineus*, which is a serious pest of palms in the Middle and Far East, could be introduced into Florida with improperly refined and composted coir (*i.e.*, moist and still fermenting). Unfortunately, *Rhynchophorus ferrugineus*, was reported by the California Department of Food and Agriculture on 18 October 2010 infesting palms in Laguna Beach, Orange County, California.

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C.I.H. Descriptions of
Plant-parasitic Nematodes
Set 5, No. 72

RHADINAPHELENCHUS COCOPHILUS

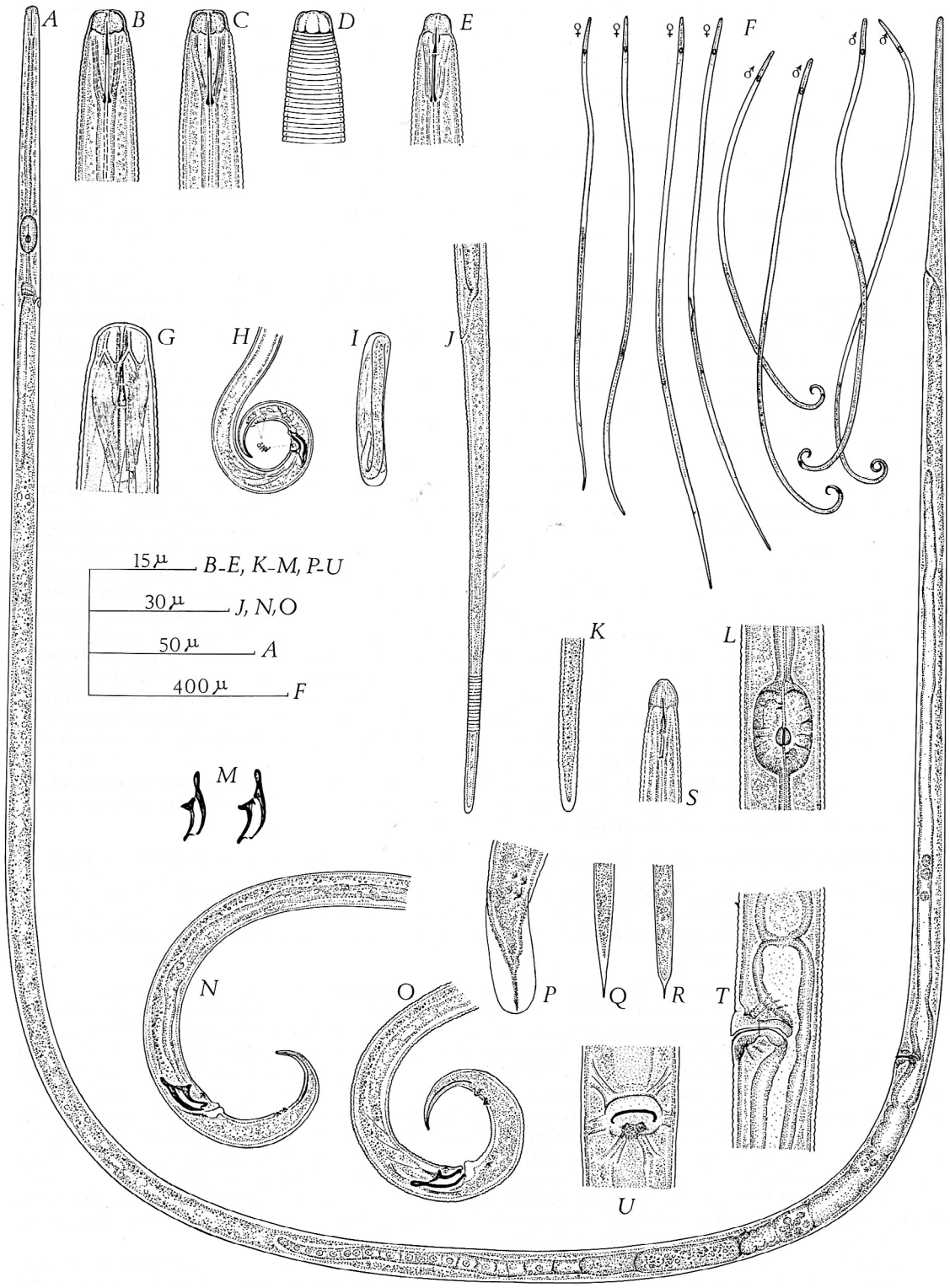

Fig. 1. *Rhadinaphelenchus cocophilus*. A & F. Adults. B–D & G. Female head ends. E. Male head end. H, N & O. Male tail ends. I. Egg. J. Female tail. K. Female tail tip. L. Female median oesophageal bulb. M. Spicules. P. Bursa in dorsal view. Q & R. Larval tail tips. S. Larval head end. T & U. Vulva in lateral and ventral view, respectively. (G, H & I after Cobb (1919); rest M.R. Siddiqi, original.)

Fig. 1. *Bursaphelenchus cocophilus* (= *Rhadinaphelenchus cocophilus*). A, F: Adults. B-D, G: Female heads. E: Male head. H, N, O: Male tails. I: Egg. J: Female tail. K: Female tail tip. L: Female median esophageal bulb. M: Spicules; P: Bursa in dorsal view. Q, R: Juvenile tail tips. S: Juvenile head. T, U: Vulva in lateral and ventral view, respectively. (Plate reproduced from Brathhwaite, C. W. D. and R. Siddiqi (1975). C.I.H. Descriptions of Plant-parasitic Nematodes Set 5, No. 72. Commonwealth Institute of Helminthology, St. Albans, Hearts, England.)

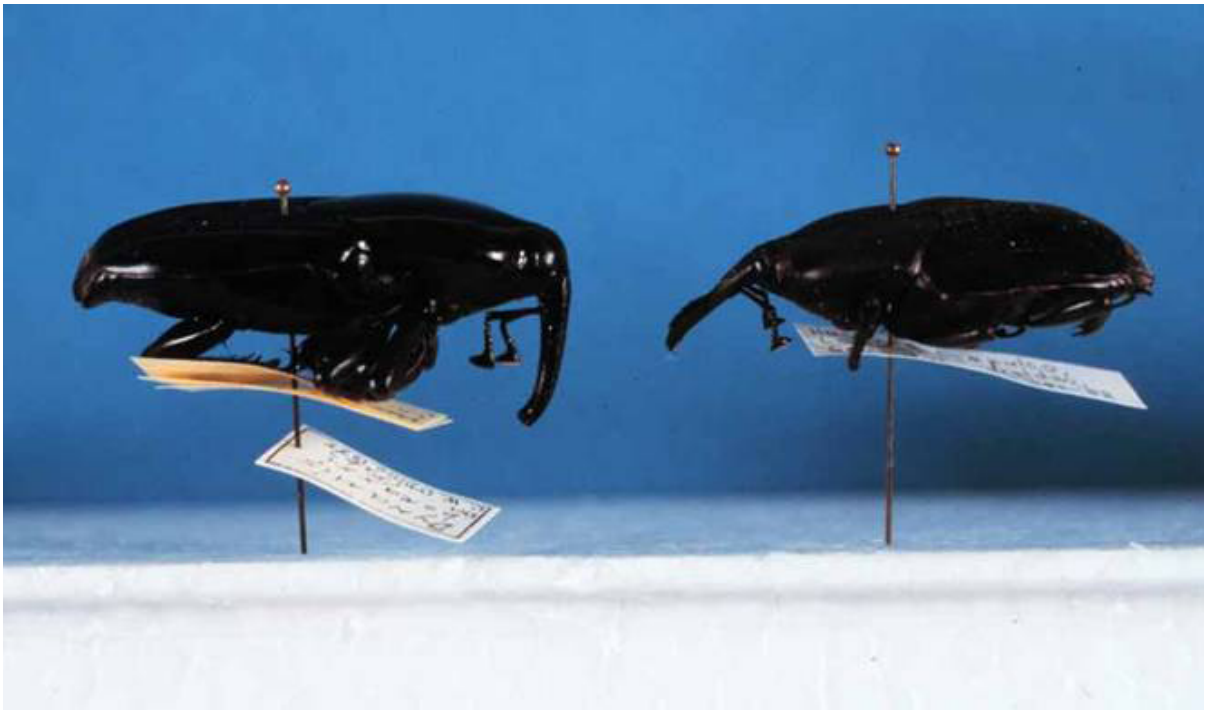

Fig. 2. Male *Dynamis borassi*, left; male *Rhynchophorus palmarum*, right. Photograph courtesy of Robin Giblin-Davis.

Fig. 3. Larvae of *Rhynchophorus palmarum*. Photograph courtesy of Robin Giblin-Davis.

Fig. 4. Cross sections of coconut palm with classical red ring symptoms. Photograph courtesy of Robin Giblin-Davis.

Fig. 5. Coconut palm with classical red ring symptoms, Trinidad. Photograph courtesy of Robin Giblin-Davis.